



MEMORANDUM

To: Executive Committee of Faculty Council

From: Professor Markus Bussmann
Chair, Engineering Graduate Education Committee (EGEC)

Date: September 30, 2013 for October 18, 2013 Faculty Council Meeting

Re: EGEC Information Report

REPORT CLASSIFICATION

This is a routine or minor policy matter that will be considered by the Executive Committee for approving and forwarding to Faculty Council for information.

New Courses Approved

AER1322H	Modern Aircraft Propulsion
AER1416H	Uncertainty Quantification
APS1023H	New Product Innovation
APS1024H	Infrastructure Resilience Planning
APS1025H	Infrastructure Protection
CIV 1190H	Structures under Blast and Impact
ECE1657H	Game Theory and Evolutionary Games
ECE1782H	Programming Massively Parallel Multiprocessors and Heterogeneous Systems
MSE1033H	Advanced Rate Phenomena in Materials Processing
MIE1199H	Special Topics in Thermal Sciences
MIE1515H	Information Privacy and Security

New Emphasis Approved

A new emphasis in Sustainable Aviation is one of the initiatives under the NSERC Collaborative Research and Training Experience (CREATE) Training Program in Sustainable Aviation and the Centre of Research in Sustainable Aviation. The Emphasis in Sustainable Aviation is aimed at graduate students and emphasises the scientific and engineering disciplines responsible for the knowledge and skills needed to build future generations of aircraft which have reduced environmental impact. It addresses the strategic target area of environmental science and technologies through its focus on environmental science and the engineering technologies needed to mitigate the impact of aircraft on the

environment. This emphasis will provide students with the skills appropriate for both industrial and academic career paths, and will therefore increase Canada's research and development capacity. Students will gain the interdisciplinary technical skills necessary to understand the relationship between the science of climate change and the engineering of aircraft, coupled with insights into the political and legal framework surrounding climate change. The students will be exposed to a unique range of topics, including aerodynamics, flow control, microarchitected composite materials, combustion, aeroacoustics, multidisciplinary optimization, biofuels, lifecycle analysis, atmospheric physics, and political, legal, and economic aspects of aviation and climate change. This material will be conveyed to them by a group of recognized experts, including the applicants and the collaborators, from industry and academia in Canada, the US, and the UK.

In addition, students enrolled in the emphasis will have access to professional development opportunities to provide them with the skills demanded by high-tech employers in Canadian industry: communication, management and teaching skills.

Flex-Time Option in PhD Programs

The Department of Chemical Engineering and Applied Chemistry, and the Institute for Aerospace Studies propose to introduce a flexible-time (or “flex-time”) option to their existing full-time programs, to begin in September 2014. The flex-time Ph.D. option would allow these units to admit a few highly-qualified and highly-motivated Ph.D. students who are also employed full-time as practicing engineers. The School of Graduate Studies considers this a “minor modification to the graduate curriculum”.

Chemical Engineering & Applied Chemistry

Students in the flex-time PhD program will be subject to the same requirements as students in the full-time program: completion of 6 half-credit (H) courses, completion of CHE300xH-Seminars in Chemical Engineering, participation in the non-credit graduate student seminar course CHE2011(H) or equivalent in collaborative programs, completion of CHE2222H-Safety Training Workshop and JDE1000H-Ethics in Research, and participation in reading committee meetings (at least once a year) that confirm that the student remains in good academic standing.

To accommodate the additional time likely required to take 6 half courses, the deadline for a qualifying exam would be extended to 16 months from initial registration. The time to achieve Candidacy would remain at 3 years, as it is for the regular program. The normal program length would be extended to 6 years for the flex-time PhD. The time limit for the degree is 8 years.

Institute for Aerospace Studies

There are a small number of inquiries from practicing professionals in the Canadian aerospace sector to pursue PhD program at the UTIAS. The PhD program will provide an opportunity for these senior staff to enhance their research skillset and to further their career path in the field. Due to their full-time employment status, it is difficult to undertake this program. A flexible-time option may open the opportunity to these prospective students. It is expected that this option will be excised very cautiously, to make sure the quality of our PhD program is maintained. The admission and program requirements of the flexible-time are the same as those of the full-time program, except in some specific timelines: flexible-time PhD students have 12 months to prepare for their first doctoral examination committee meeting (rather than 6 months for full-time PhD students), 24 months for their second meeting as the qualifying exam (rather than 18 months for full-time PhD students). The normal length of the flexible-time PhD program is six years rather than four. In addition, flexible-time PhD students are not eligible for financial support.

Governance Form A – GCT# 4368, Posted Fri Aug 23, 2013

Proposal Type:

X	New Emphasis in Existing Program
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Faculty: Faculty of Applied Science and Engineering

Name of Graduate Unit: Institute of Aerospace Studies

Graduate Programs Involved in Proposal: Aerospace Science and Engineering: MEng, MAsC, PhD

Brief Summary of Proposed Change(s):

A new Emphasis in Sustainable Aviation is proposed. Emphasis requirements are:

A. Doctoral stream (MAsC/PhD)

- i) At least 2 courses (1.0 FCE) from the list of courses below plus AER1315H (0.5 FCE); and
- ii) A thesis project in an area of relevance to sustainable aviation; topics will require approval of the Scientific Committee.

B. MEng

At least 5 courses (2.5 FCE) from the list plus AER1315H (0.5 FCE)

Eligible Courses

AER1315H Sustainable Aviation
AER1303H Advanced Fluid Mechanics
AER1304H Fundamentals of Combustion
AER1306H Special Topics in Reacting Flows (reading)
AER1308H Introduction to Modern Flow Control
AER1310H Turbulence Modelling
AER1316H Fundamentals of Computational Fluid Dynamics
AER1318H Topics in Computational Fluid Dynamics
AER1319H Finite Volume Methods for CFD
AER1403H Advanced Aerospace Structures
AER501H Advanced Mechanics of Structures
AER510H Aerospace Propulsion
CIV1307H Lifecycle Assessment of Engineering Activities
PHY1498H Introduction to Atmospheric Physics
PHY2505H Atmospheric Radiative Transfer and Remote Sounding
PHY2504H Atmospheric Dynamics
CHE1123H Liquid Biofuels
JCC1313H Environmental Microbiology

Rationale:

The Emphasis in Sustainable Aviation is one of the initiatives under the NSERC Collaborative Research and Training Experience (CREATE) Training Program in Sustainable Aviation and the Centre of Research in Sustainable Aviation. The Emphasis in Sustainable Aviation is aimed at graduate students and emphasises the scientific and engineering disciplines responsible for the knowledge and skills needed to build future generations of aircraft which have reduced environmental impact. It

addresses the strategic target area of environmental science and technologies through its focus on environmental science and the engineering technologies needed to mitigate the impact of aircraft on the environment. This emphasis will provide students with the skills appropriate for both industrial and academic career paths, and will therefore increase Canada's research and development capacity. Students will gain the interdisciplinary technical skills necessary to understand the relationship between the science of climate change and the engineering of aircraft, coupled with insights into the political and legal framework surrounding climate change. The students will be exposed to a unique range of topics, including aerodynamics, flow control, microarchitected composite materials, combustion, aeroacoustics, multidisciplinary optimization, biofuels, lifecycle analysis, atmospheric physics, and political, legal, and economic aspects of aviation and climate change. This material will be conveyed to them by a group of recognized experts, including the applicants and the collaborators, from industry and academia in Canada, the US, and the UK.

In addition, students enrolled in the emphasis will have access to professional development opportunities to provide them with the skills demanded by high-tech employers in Canadian industry: communication, management and teaching skills.

Does this change have any financial and/or resource implications? [Mark one]

☒ NO	☐ YES (please contact Faculty Graduate Dean's Office and provide brief description below)
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Effective Session Date:
September 2013

Approvals/Actions prior to Faculty governance approval:

- [Graduate Unit Committee Name, Meeting Date]
 - o Approval of NSERC CREATE Program in Sustainable Aviation, April 2012
 - o UTIAS Curriculum Committee, June 28, 2013
- [Consultations]
 - o A Trainee Advisory Committee (TAC) was created as part of the NSERC CREATE Program in Sustainable Aviation. TAC will represent the interests of the students, graduate and undergraduate and post-doctoral fellows who are associated with the program by reporting to the Training Program Committee directing the Centre for Research in Sustainable Aviation.

Chair/Director Name(s): [Name of the Graduate Chair/Director of the unit(s) involved. Also list names and contact information for other individuals who will attend meetings at which the proposal will be discussed.]

- Zingg, David, Professor and Director, University of Toronto Institute for Aerospace Studies and Director, Centre for Research in Sustainable Aviation, University of Toronto Institute for Aerospace Studies
- Lavoie, Philippe, Associate Professor and Associate Director, Center for Research in Sustainable Aviation, University of Toronto Institute for Aerospace Studies
- Steeves, Craig, Assistant Professor and Associate Director, Center for Research in Sustainable Aviation, University of Toronto Institute for Aerospace Studies

Date: June 21, 2013

Faculty Council/Delegated Body Meeting Date: [Identify the Faculty Council or delegated body that will consider the proposal for final approval and provide the expected meeting date.]

- Engineering Graduate Education Committee - July 15, 2013
- FASE Executive Committee - September 27, 2013
- FASE Faculty Council - October 18, 2013

Aerospace Studies

Faculty Affiliation

Applied Science and Engineering

Degree Programs Offered

Aerospace Science and Engineering – MASc, MEng, PhD

Overview

The University of Toronto Institute for Aerospace Studies (UTIAS) offers graduate programs leading to research-intensive **Master of Applied Science** and **Doctor of Philosophy** degrees and a professionally oriented **Master of Engineering** degree. Faculty research areas include aircraft flight systems and control, flight simulation, computational fluid dynamics, combustion and propulsion, aerodynamic shape optimization, experimental fluid dynamics, flow control, structural mechanics, advanced composite materials, multidisciplinary optimization of aircraft, multifunctional systems, spacecraft dynamics and control, autonomous space robotics, microsatellites, space mechatronics, plasma-materials interactions, and materials for fusion reactors. Details of entrance regulations and courses of study are given in this calendar and on the UTIAS website.

Contact and Address

Web: www.utias.utoronto.ca

Telephone: (416) 667-7714

Fax: (416) 667-7743

University of Toronto Institute for Aerospace Studies
Room 169, 4925 Dufferin Street
Toronto, Ontario M3H 5T6
Canada

Degree Programs

Aerospace Science and Engineering

Master of Engineering

Minimum Admission Requirements

- Applicants holding an appropriate bachelor of applied science degree in engineering are considered for admission under the General Regulations of the School of Graduate Studies.

Program Requirements

- Under the guidance of the Graduate Coordinator or a staff supervisor, a student selects a program of study that consists of at least 10 half courses (5.0 full-course equivalents [FCEs]). Individual programs will be arranged to make up for background deficiency. The program may be pursued on a full-time, extended full-time, or part-time basis. On a full-time basis, completion is possible in three sessions. With the extended full-time option, students are expected to complete the requirements in six sessions (two years) and are limited to 6 half courses per year and 3 half courses per session. Part-time students are limited to 4 half courses per year and 2 half courses per session. Time to completion for part-time students will be greater than two years.

Program Length: 3 sessions full-time; 6 sessions extended full-time; 9 sessions part-time

Time Limit: 3 years full-time and extended full-time; 6 years part-time

Master of Applied Science

Minimum Admission Requirements

- Applicants are admitted under the General Regulations of the School of Graduate Studies. Qualified graduates in engineering, mathematics, physics, or chemistry are encouraged to apply. Individual programs are arranged to make up for background deficiencies.

Program Requirements

- Minimum of 2.5 full-course equivalents (FCEs), of which 0.5 FCE must be AER 1800H Research Seminar in Aerospace Science and Engineering. All required courses must be completed during the first year of the program.
- A thesis based on research or development, selected in consultation with the student's supervisor.
- Research performance is assessed by a Research Assessment Committee (RAC), which includes the student's supervisor.
- MASc students are anticipated to complete their degree requirements in 18 months.
- Students interested in pursuing a PhD degree, who have achieved excellent performance in an MASc program at UTIAS, are encouraged to transfer directly into a PhD program, under the same supervisor, at the end of their first year of MASc studies. Approval for transfer is based on the student's research ability, research progress during the first year, and academic standing. Students transferring from an MASc to a PhD program shall be referred to as "transfer students."

Normal Program Length: 5 sessions full-time

Time Limit: 3 years full-time

Doctor of Philosophy

Minimum Admission Requirements

- An MASc degree in engineering, mathematics, physics, or chemistry and demonstrated ability to perform advanced research. Applicants with an appropriate bachelor's degree from a recognized university who wish to pursue PhD studies at UTIAS will initially be admitted into the MASc program and will be considered for direct transfer into the PhD program.

Program Requirements

- Full-time continuous registration for every session, including the summer session, until all degree requirements are completed. PhD students starting with an MASc or MEng degree must spend a minimum of two years in the program. Transfer students spend a minimum of three years in the program from the date of registration in the MASc program.
- Following acceptance into a PhD program, the student shall undertake a program of study under the guidance of a Doctoral Examination Committee (DEC) which includes the student's supervisor.
- Coursework and a thesis which must be based on research conducted while registered for the PhD program. PhD students starting with an MASc or MEng degree require 2.0 full-course equivalents (FCEs). Transfer students need 1.0 FCE in addition to the 2.5 FCEs completed prior to the MASc to PhD transfer for a total of 3.5 FCEs. All courses must be completed during the first two years in the PhD program.
- A student with a master's degree in a discipline appropriate to the field of PhD study is anticipated to complete the PhD program on a full-time basis in less than four years. The anticipated period for transfer students is less than five years from the date of registration in the MASc program. The DEC plays an important role in assisting students to meet this goal. The functions of the DEC are to:
 - ascertain the suitability of the student for advanced research,
 - assess the thesis topic,
 - conduct formal reviews of the student's progress at least once a year (unsatisfactory progress may result in the termination of the student's candidacy), and
 - provide first assessment of the completed thesis.
- Program milestones:
 1. The first DEC meeting is held within six months of PhD program start (or date of transfer for transfer students); the aim is to identify the topic and scope of the thesis.
 2. The second DEC meeting (approximately 1.5 years after PhD start) is the Qualifying Examination, which determines whether the student should continue in the program or whether his or her candidacy should be terminated.
 3. Subsequent DEC meetings are held at least once a year.
- Upon thesis completion, the student presents the thesis at a Departmental Doctoral Seminar before defending it at the Doctoral Final Oral Examination as prescribed under the SGS Degree Regulations in this calendar.
- Prior to convocation, PhD students must prepare at least one formal manuscript, based on the thesis, for publication in refereed journals or refereed conference proceedings.

Normal Program Length: 4 years full-time; 5 years direct-entry

Time Limit: 6 years full-time; 7 years direct-entry; 7 years transfer-from-master's

Emphasis: Sustainable Aviation

Students from the MSc/MEng/PhD programs have the option of completing an emphasis in Sustainable Aviation as part of their respective degree program.

A. Doctoral stream (MSc/PhD)

- i) Doctoral stream students must take at least 2 courses from the list of courses below plus AER1315 Sustainable Aviation;
- ii) Doctoral stream students must complete a thesis project in an area of relevance to sustainable aviation; topics will require approval of the Scientific Committee.

B. MEng students must take at least 5 courses from the list plus AER1315.

2) Eligible Courses

AER1315 Sustainable Aviation
AER1303 Advanced Fluid Mechanics
AER1304 Fundamentals of Combustion
AER1306 Special Topics in Reacting Flows (reading)
AER1308 Introduction to Modern Flow Control
AER1310 Turbulence Modelling
AER1316 Fundamentals of Computational Fluid Dynamics
AER1318 Topics in Computational Fluid Dynamics
AER1319 Finite Volume Methods for CFD
AER1403 Advanced Aerospace Structures
AER501 Advanced Mechanics of Structures
AER510 Aerospace Propulsion
CIV1307 Lifecycle Assessment of Engineering Activities
PHY1498 Introduction to Atmospheric Physics
PHY2505 Atmospheric Radiative Transfer and Remote Sounding
PHY2504 Atmospheric Dynamics
CHE1123 Liquid Biofuels
JCC1313 Environmental Microbiology

Course List

This list represents course offerings at the time of publication. Course descriptions are available on the UTIAS website. Courses marked (PR) have prerequisites.

Aircraft Flight Systems

AER 0503H Aeroelasticity
AER 1202H Advanced Flight Dynamics
AER 1211H Human Control of Flight Systems
AER 1214H Airplane Dynamics (Flight Laboratory)
AER 1215H Aerodynamics and Flight Mechanics of Rotorcraft

Aerodynamics, Fluid Dynamics, and Propulsion

AER 0510H	Aerospace Propulsion
AER 1301H	Kinetic Theory of Gases
AER 1303H	Advanced Fluid Mechanics (PR)
AER 1304H	Fundamentals of Combustion
AER 1306H	Special Topics in Reacting Flows
AER 1308H	Introduction to Modern Flow Control
AER 1310H	Turbulence Modelling
AER 1311H	Unsteady Gasdynamics
AER 1315H	Sustainable Aviation
AER 1316H	Fundamentals of Computational Fluid Dynamics
AER 1318H	Topics in Computational Fluid Dynamics
AER 1319H	Finite Volume Methods for Computational Fluid Dynamics
AER 1320H	Air-Breathing Propulsion

Structures and Multidisciplinary Optimization

AER 0501H	Advanced Mechanics of Structures
AER 1403H	Advanced Aerospace Structures (PR)

Space Systems Engineering

AER 0506H	Spacecraft Dynamics and Control I
AER 0525H	Robotics
AER 1503H	Spacecraft Dynamics and Control II
AER 1512H	Multibody Dynamics
AER 1513H	State Estimation for Aerospace Vehicles
AER 1514H	Mobile Robotics
AER 1515H	Intelligent Robotics
AER 1520H	Microsatellite Design I
AER 1521H	Microsatellite Design II

Engineering Physics

AER 0507H	Introduction to Fusion Energy
AER 1717H	Applied Plasma Physics I (reading course)
AER 1720H	Applied Plasma Physics II (reading course)

Research Seminars and Professional Courses

AER 1800H	Research Seminar in Aerospace Science and Engineering (for first-year MSc students only)
AER 1810H	MEng Project (for MEng students only)
JDE 1000H	Ethics in Research (Students registered in the MSc or PhD programs are required to participate in this non-credit seminar course during their first or second session of registration. This course must be completed in order to graduate.)